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with a large centrally situated cell that divides into two. Of these two cells, the lower develops into the egg cell, or oosphere; the upper develops into a tube which becomes filled with a mucilaginous substance that is afterwards discharged, leaving the passage to the oosphere open.

More distant from the sinus of the prothallium are the *antheridia*, situated among the root hairs. In these spirally coiled antherozoids are developed, being finally discharged by the rupture of the cell wall. Accompanying each antherozoid is a small cell, the use of which is not understood. Each antherozoid is provided with cilia, by means of which it swims about when the prothallium is wet. It may in this way pass to other prothallia, where, by fertilizing the oosphere, a hybrid variety is produced (p. 185).

Two groups of plants included here are *heterosporous*, *i. e.*, they have two kinds of spores, female macrospores and male microspores (p. 186).

The plant is the sporophyte (the spermatophytes). There are two kinds of spores, microspores or pollen grains, and macrospores borne in embryo sacs (p. 205).

The feature that especially distinguishes the spermatophytes from the plants of the seven preceding subdivisions is the production of true seeds, which are the result of the fertilization of the embryo cell by the receipt of the contents of the pollen cell. The embryo cell is borne in a pistil (p. 206).

The ovules are borne in closed cavities, the *ovaries*, at the base of *pistils*, which are modified leaves; the pollen cells are borne in anthers raised on stamens; which are also modified leaves (p. 218).

The contents of the pollen grain now mingle with those of the embryo sac, and the life of the seed commences (p. 219).

Some plants develop their leaves alternately; others develop them in pairs. From these facts have arisen a division of the angiosperms (into monocotyls and dicotyls) (p. 220).

The above quotations need no comment, and could some of the illustrations be reproduced the same remark would be appropriate, although some well-known and classic illustrations help the general average.—J. M. C.

Essays on plant life.

POPULAR books about plants are few. Accurate and interesting books about plants are rare indeed. We justly welcome, therefore, a book, embodying these qualities, which has lately been issued by Dr. J. C. Arthur of Purdue University and Dr. D. T. McDougal of the University of Minnesota.³ It consists of twelve essays, selected in equal numbers by the two authors from popular addresses and articles presented within the last few years. These have been more or less modified to adapt them to each other and to current botanical knowledge. It will not be amiss to quote the titles of the essays to indicate in a measure the compass of the book.

³ ARTHUR, J. C., and MACDOUGAL, D. T.—Living plants and their properties; a collection of essays. Small 8vo., pp. x + 234. *figs.* 28. New York; Baker & Taylor. Minneapolis: Morris & Wilson. 1898.

The six by Dr. Arthur are: The special senses of plants; Wild lettuce as weed and compass plant; Universality of consciousness and pain; Two opposing factors of increase; The right to live; Distinction between plants and animals.

The six by Dr. McDougal are: The development of irritability; Mimosa, a typical sensitive plant; How cold affects plants; Chlorophyll and growth; Leaves in spring, summer, and autumn; The significance of color.

Into a detailed examination of the essays we cannot go. All are well written and interesting. Dr. McDougal's deal chiefly with important facts of plant activity, while Dr. Arthur's are inclined to be more speculative and philosophical. The latter, therefore, offer the greatest opportunity for criticism. Few will be able to concede the correctness of the author's definitions and premises in the essay on the Universality of consciousness and pain, wherein he seeks to maintain the thesis that "all living organisms, whether animal or plant, are capable of conscious pain to a degree commensurate with the requirements of their nature." Indeed, he seems to destroy his own argument by concessions. For at the outset he excludes from consciousness, as he uses it, all idea of self-consciousness, which, he adds, "is necessary that the individual may, for instance, be aware of its own identity" (p. 65). Later he says: ". . . when the organism is aware of a feeling of pleasure or pain, or of any other sensation, *knowing that the same is located within its own organs*, it is possessed of consciousness" (p. 71).

Nor can we believe that Dr. Arthur has really found in the "carbohydrous investment" of plants, and the "nitrogenous investment" of animals, a "crucial test" for distinguishing them. Who can accept a criterion which, the author says, excludes the Olpidiaceæ and the Synchytriaceæ from the rest of the Chytridineæ? Does not the argument "it is known with much certainty that they have no cellulose envelope; they are, therefore, not plants, and must, in consequence, be animals," beg the whole question?

It is a pity that the book should be so poorly manufactured. Bad proof-reading and a "countrified" binding, spoiling the artistic cover design, show the novice hand of the Minneapolis firm which did the mechanical part. The work of the authors deserves a better setting. The book may well find a place in public and school libraries, and is commended for popular reading.—C. R. B.

The phytogeography of Nebraska.⁴

THIS is a distinct and noteworthy addition to the ecological plant geography of this country. It is a general survey, the first of a series of install-

⁴ POUND, ROSCOE and CLEMENTS, FREDERIC E. — The phytogeography of Nebraska. I. General Survey. 8vo., pp. xxi + 330. Lincoln, Nebraska: Jacob North & Co. 1898.